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Achieving sustainability transitions in residential energy use across Europe: The importance of problem framings

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ABSTRACT

Reducing greenhouse gas emissions in the residential sector is central to European energy policy. However, the speed and scale of sustainable energy transitions need to accelerate. There is a growing consensus that meeting energy targets is highly dependent on interrelated socio-material and cultural aspects of energy use. New ways of framing energy demand that go beyond dominant efficiency- and behavior models are needed. Recognizing these concerns, this paper reports on a review of 1067 Sustainable Energy Consumption Initiatives (SECIs) that aim to reduce residential energy use across 30 European countries. The initiatives are categorized and a corresponding Problem Framing Typology (PFT) is developed, highlighting important aspects of different types of problem framings. The typology contains four categories including 1) Changes in technology; 2) Changes in individual behavior; 3) Changes in everyday life situations; 4) and Changes in complex interactions. Applying the PFT to the 1067 SECIs shows that the vast majority (75%) of SECIs are positioned within category 1 and 2, indicating a lingering bias towards technocratic consumer behavioral strategies. The limitations of such approaches are discussed, and it is argued that systematically addressing interactions between technology, businesses, culture and everyday-life is more likely to lead to long-term transformation.

1. Introduction

In response to the increasingly urgent climate change challenge, the European Commission is promoting several climate and energy targets, which attempt to reduce greenhouse gas emissions and decarbonize the economy. However, the current scale of change is insufficient to achieve the necessary sustainability transition in the energy system (COP21; Geels et al., 2017). There is an increasing realization that meeting energy targets is highly dependent on several complex aspects of final energy consumption patterns (EEA Signals 2017). Numerous academic claims assert that current endeavours to implement energy efficiency policies are not appropriately dealing with social and cultural aspects of energy use, thereby limiting their potential for initiating long-term transformation (e.g. Foulds and Christensen, 2016; Genus et al., 2018; Southerton and Welch, 2018).

Reasons for current shortcomings may be multiple, but, notably, energy efficiency strategies often depend on abstracting efficient (as well as inefficient) solutions from the social organization within which these solutions unfold. This somewhat dominant perspective suggests that energy efficiency strategies assume that solutions can be "surgically removed and replaced by other solutions, seamlessly entering the social tissue where they are installed, without causing any change but reduction in energy inputs" (Labanca and Bertoldi, 2018, p. 496). These assumptions, however, completely disregard any potential impacts occurring due to technological changes, which often include so-called rebound effects as well as increases in (other) resource intensive activities (ibid), such as more time or money to do other things. Shove (2017) argues that these (counter-productive) results of energy efficient improvement strategies are due to the fact that the ways of thinking about energy efficiency are themselves 'performative' and that they end up perpetuating meanings and levels of services related to existing (unsustainable) types and patterns of consumption, rather than effectively challenging them.

Labanca and Bertoldi (2018) argue that the main ingredients of current policies concerning energy use can be described as understanding changes in energy consumption as a mix of behaviorally, economically or technologically driven energy efficiency improvements (p. 495), a view shared by Foulds et al. (2017) in a recent report on the role that social science and humanities play in energy related research. This tradition in much energy related research and policy has taken hold in spite of the fact that an increasing number of studies show that technological (efficiency) improvements alone will not meet the

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required reductions in carbon emissions, and targeting individual behaviors brings about limited changes in actual energy consumption patterns (e.g. Fuchs and Lorek, 2005; de Koning et al., 2016; Foulds and Christensen, 2016; Bjørn et al., 2018; Southerton and Welch, 2018; Thomas and Rosenow, 2019).

Thus, there is a need for better understanding as to how and in what ways current sustainable consumption initiatives are framed, and what type of knowledge as well as results they are likely to facilitate. In the following, an overview is given of current trends as well as prevailing knowledge gaps.

1.1. Types of sustainable consumption initiatives

There is increasing recognition that society cannot continue to operate by way of a 'business as usual' approach, and there needs to be a fundamental shift to more sustainable patterns of production and consumption (Stern, 2008; Alfredsson et al., 2018; Bjørn et al., 2018; Southerton and Welch, 2018). Such a transformation will require the development, adaptation and diffusion of new technologies, as well as (radical) changes in socio-material organization of resource-intensive practices (Jensen et al., 2018). Therefore, sustainable transitions are understood to be multi-dimensional and multi-scalar, and sustainable consumption initiatives conducted across the world are indeed multifaceted in content, scale and approach (Southerton and Welch, 2018). Unsurprisingly, researchers, businesses, policy-makers and practitioners involved in such initiatives come from myriad backgrounds and disciplinary approaches, which brings a broad diversity in perspectives, goals and agency (as evident from activities within larger networks related to understanding and supporting systems of sustainable consumption and production such as SCORAI[1] and Future Earths SSCP KAN[2]). Likewise, several research projects are committed to researching and disseminating knowledge and results from ongoing sustainable consumption initiatives. For instance, SHARECITY reports on scale, content and performance of a range of food sharing initiatives (Davies et al., 2017) and Jaeger-Erben et al. (2015) report on the innovativeness, formality, communality and personal engagement of numerous social innovation initiatives towards sustainable consumption.

Yet, although it is recognized that sustainable consumption initiatives are and should be heterogeneous and respond to several, complex problems related to consumption, abstract energy efficiency strategies, as described above, are often the go-to solution in much (policy) debates of sustainable *energy* consumption issues and related energy use reduction potentials (as for instance identified by Foulds and Christensen, 2016; Castree and Waitt, 2017; Labanca and Bertoldi, 2018; Southerton and Welch, 2018; Goggins et al., 2019). Scepanovic et al. (2017) report on a large-scale review of 'energy initiatives', where they categorize these in correspondence to whether they seem information-based, gamification-based or more structurally oriented. Although the review and assessment they provide is wide-ranging, the classification primarily resonates with prevailing problem framings that tend to understand change in energy consumption as a matter of technological change or change in individual behaviors, even if individual behaviors can be understood as pooled together and 'nudged' in particular social 'contexts' such as through competition. The classification proposed by Scepanovic et al. (2017) supports the claim that energy initiatives are multifaceted, but it also demonstrates the relatively narrow range of problem framings that underpin the 'approaches' they identify. A somewhat broader perspective of problem framings is presented by Heiskanen et al. (2018) in their identification of five basic designs for initiatives that seek to reduce household energy use or carbon emissions in real-word settings. The five categories of approaches respond to different contexts ranging from overcoming individualized problems (e.g. high-fuel bills) addressed through *needs-based tailored support* to the promotion of new sustainable ways of living addressed through *pioneering practices* approaches. The study also emphasizes the importance of considering 'contextual' conditions, underlying problem framings and change mechanisms for the transferability of results.

In summary, there is a remaining and growing call for an improved understanding and integration of the socially shared and institutionalized dimensions of energy consumption in approaches towards lowering energy use (as identified by Shove, 2010; Genus and Jensen, 2017; Genus et al., 2018; Castree and Waitt, 2017; Geels et al., 2017). At the same time, there is a seemingly conflicting tendency to keep reproducing mainstream, somewhat technocratic approaches to energy-use reduction in policies (as identified by Foulds et al., 2017; Labanca and Bertoldi, 2018; Southerton and Welch, 2018).

The discrepancy between dominant problem framings and the need for reconceptualized problem framings therefore deserves continued attention. While there are several smaller-scale, empirical studies demonstrating the value of acknowledging socially shared and institutionalized dimensions of energy consumption (e.g. Hand and Shove, 2007; Gram-Hanssen, 2013; Jensen, 2014) the dataset upon which this paper draws provides an important opportunity to map the (sometimes implicit) understandings of perceived energy-reduction potentials that take place in sustainable energy initiatives on a *large scale*.

In order to better understand why and in what way current traditions in energy policy take hold in practice, this paper presents and discusses the typological assessment of 1067 Sustainable Energy Consumption Initiatives (SECIs) implemented across Europe. The 1067 initiatives reviewed comprise a critical case for the typological assessment, to ensure a broad variety of SECIs typologized. The typology contains four categories, all of which are developed according to how the empirical data corresponds to the analytical interest in reviewing and highlighting different kinds of *problem framings* within energy consumption initiatives. The categories include 1) Changes in technology; 2) Changes in individual behavior; 3) Changes in everyday life situations; 4) and Changes in complex interactions. The collection, review and assessment of the SECIs have been carried out as part of the ENERGISE project.

The paper unfolds as follows; section 2 focuses on how problem framings can be researched, described and typologized. Section 3 elaborates on the methodological work with identifying and assessing sustainable energy consumption initiatives in the context of the ENERGISE project. Section 4 presents the problem framing typology in greater detail, and provides illustrative examples of initiatives that fall under each category. Section 5 provides a discussion of the policy implications of the results, while section 6 concludes with some succinct recommendations as well as suggestions for future research.

2. Exploring problem framings in sustainable consumption initiatives

As discussed by Smith et al (2010), 'problem framings' can be described as the process of defining the purpose and outcomes of innovative activity as well as delineation of the 'thing' that undergoes change. On a more philosophical note, Dewey (1938) suggests that 'without a problem, there is blind groping in the dark. The way in which a problem is perceived decides which specific suggestions are entertained … ' (p. 112). Picking up on these reflections, it is interesting to highlight what Southerton and Welch (2018) describe as the discrepancy between policy approaches that a) entertain behavior-change

[1] Sustainable Consumption Research and Action Initiative.

[2] Systems of Sustainable Consumption and Production Knowledge Action Network.

Table 1
Different types of problem framings in policy interventions (Jensen et al., 2018, adapted from Spurling et al., 2013).

Problem Framing	Target of Intervention
Common framings in current policy interventions	
1. Innovating technology	Reduce the resource intensity of existing patterns of consumption through technical innovation and optimization.
2. Shifting Consumer Choices	Encourage consumers to choose more sustainable or energy efficient products.
3. Changing Behavior	Encourage individuals to adopt more sustainable behaviors and efficient and to discourage them from less efficient behaviors.
Framings drawing on a practice perspective	
4. Re-crafting Practices	Reduce the resource intensity of existing practices through changing the components, which make up those practices.
5. Substituting Practices	Replace less sustainable practices with more sustainable alternatives, with an eye to how alternative practices can fulfill similar purposes.
6. Changing how Practices Interlock	Social practices interlock with each other - for example: mobility, shopping and eating. Changing the way they interlock means exploring and harnessing the complex interactions between practices.

initiatives that frame sustainable consumption as mediated through 'informing, enabling or nudging individual consumers toward more sustainable choices, almost always in the context of markets' and b) frame sustainable consumption as mediated through disrupting and reconfiguring systems of production and consumption. These two generalized policy approaches suggest two entirely different problem framings related to potentials for change. This resonates well with earlier work developed by Southerton et al. (2011), where they propose that mechanisms employed in behavior change initiatives tend to address one, and sometimes more, contexts in which behavior might be changed. These include 1) the individual, which refers to focusing on influencing the attitudes, behaviors and choices of the individual consumer, 2) the social, which refers to paying attention to social norms, cultural conventions and shared understandings of consumer practices, and 3) the material, which refers to the objects, technologies and infrastructures that both enable and constrain ways of behaving. In their international review, Southerton et al. (2011) find that behavior change initiatives that target multiple contexts, multiple moments of lifestyle transitions, and institutional or infrastructural pressure points are more likely to be successful. Equally, they find that there is untapped potential in exploring opportunities for developing frameworks for coordinated initiatives across sectors and systems. Finally they find that utilizing mechanisms that change the provisioning of goods, such as switching to renewable energy sources and drawing on 'non-environmental' issues such as health, diet and time management appear to promote 'pro-environmental' behaviors.

Building on this perspective, Spurling et al. (2013) propose six different problem framings of the sustainable transformation challenge, where three categories resemble predominant problem framings in much consumer policy, and three resemble framings that draw on a *practice theoretical* perspective (see Table 1).

The units of analyses and intervention for the framings drawing on a practice perspective, includes, but also goes beyond, traditional mechanisms that are employed in most behavior change initiatives. Ultimately, Spurling et al. (2013) argue that problem framings that draw on a practice perspective 'moves beyond individual behavior on the one hand and its context on the other —whether material infrastructure or social norms—to a unit of analysis that integrates both behaviors and their material, social and cultural contexts' (p 19). Problem framings that draw on a practice perspective would thus ideally regard spaces and mediums of intervention as the social, cultural and material underpinning of behaviors. This implies that individual behaviors are not in themselves treated as the target of intervention, but rather that the practices that organize everyday life and society in particular ways are targeted. This means that a practice based problem framing would ideally deconstruct and combine several of the elements in behavior change programs and interventions that Southerton et al. (2011) identify.

Table 2 summarizes how key research contributions have worked with identifying and characterizing dominant problem framings as well as how their suggested alternatives can be characterized.

Building on the highly relevant work summarized in Table 2, this paper proposes a framework for assessing the extent to which technocratic and behavior-change oriented approaches prevail in a wide-ranging number of recent sustainable energy consumption initiatives, and whether more systemically oriented approaches to change also take place. This is specifically done to enable a discussion around the knowledge about – and spaces for – change that are being produced by different types of problem framings, providing an important contribution for policy makers as well as sustainability researchers working with facilitating opportunities for transformative change.

In the next section, ENERGISE is briefly introduced, focusing on the conceptual and methodological work carried out in order to review and assess Sustainable Energy Consumption Initiatives (SECIs) at a large, European scale. For the purpose of this paper, the primary interest relates to how an analysis of problem framings was enabled within this larger systematic assessment.

3. Exploring and categorizing sustainable energy consumption initiatives

In ENERGISE,[3] one of the main interests of the project has been to explore social and cultural aspects of residential energy use. As part of this work, a large scale assessment of SECIs was conducted to review existing projects and uncover the knowledge and spaces for change they produce.

For the purpose of assessing problem framings related to such initiatives, SECIs are loosely defined as activities that deal with reducing energy related CO_2 emissions from households. This can either be in terms of reducing energy consumption levels by substituting fossil fuels with renewable energy sources or by reducing energy demand. In all cases, the SECIs must include an element of active involvement of households, so that SECIs included for assessment do not address energy supply alone. This distinction is important for getting more detailed insights about how the 'energy consumer' is framed, as an active involvement of the households would imply that they are seen to play some sort of engaged role in reducing energy consumption. Initiatives that understand households as 'passive' in reducing energy consumption (such as initiatives that would purely address changes in energy supply and avoid making explicit changes in energy demand patterns) are also relevant, as they build on problem framings that explicitly 'black-box' patterns of energy demand. However, given the perceived dominance of mainstream approaches that assume change to be primarily technological and behavioral, inclusion of SECIs that orient themselves at least to some extent towards an interactive, action-based approach to change comprise a critical case sample that should ensure that innovative and arguably rarer types of change initiatives would be also reviewed and assessed. Finally, the SECIs should have at least one

[3] ENERGISE is funded by the EU Horizon 2020 program (GA 727642). More information about ENERGISE can be found at http://energise-project.eu.

Table 2
Overview of key research of mainstream energy policy framings, empirical scope and suggested alternative.

Dominant policy problem framings	Critical Research	Empirical basis	Alternative policy problem framings
Independent mechanisms	Southerton et al. (2011)	Review of international initiatives, small-scale, in-depth	Integrating mechanisms
Rational-economic ontologies	Spurling et al. (2013)	Review of national initiatives (UK), small scale, in-depth	Practice theoretical ontologies
Abstract energy efficiency strategies	Labanca and Bertoldi (2018)	Review of key research and policy documents	Social dimensions embedded
STEM and psychology approaches	Foulds et al. (2017)	Review of levels of extent to which SSH is used to inform policy and research compared to more classical technical and economic approaches	SSH integration
Technical or behavioral approaches	Southerton and Welch (2018)	Review of international initiatives, small scale, in-depth	Systems perspectives

Table 3
Quantitative overview of SECIs identified and assessed[a].

Country	Nr. of SECIs identified
Austria	54
Belgium	46
Bulgaria	45
Croatia	35
Czechia	24
Cyprus	14
Denmark	36
Estonia	10
Finland	47
France	59
Germany	60
Greece	30
Hungary	45
Ireland	55
Italy	43
Latvia	27
Lithuania	19
Luxemburg	11
Malta	15
the Netherlands	47
Norway	19
Poland	31
Portugal	31
Romania	24
Slovakia	29
Slovenia	49
Spain	61
Sweden	24
Switzerland	42
United Kingdom	35

[a] A complete overview of identified, assessed and typologised SECIs can be found in the ENERGISE database http://energise-project.eu/projects.

identifiable initiator, so that (embedded) expectations from key actors can be explored. In spite of these overall criteria for inclusion, the definition of a SECI is intentionally kept broad in order to make room for empirical enquiry, such as unpacking the large variety of initiatives seeking to achieve what can be largely perceived as the same 'end-goals', such as reducing energy use or carbon emissions.

To accompany this definition, and to enable empirical enquiry, a comprehensive framework for how to assess SECIs was developed, both to ensure that only SECIs that correspond to the (albeit broad) definition were included in the database, as well as to learn from a wide range of details for each included SECI. The framework, the methodological opportunities, challenges, and the related limitations of the resulting dataset are described in detail in Jensen et al. (2018). For the purpose of this paper, a short introduction to the framework and the knowledge production it enabled is presented in the following.

3.1. Assessing and reviewing large scale datasets of SECIs

In order to explore scope, content and extent of recent and existing SECIs, a systematic criteria-based assessment of a total of 1067 SECIs across 30 European countries was carried out (see Table 3 for overview).

Generalizing (qualitative) data must correspond to particular questions and concerns, and theoretical concepts can enable a more general perspective on specific qualitative patterns. Methods of interpreting qualitative data are therefore inherently 'theory-laden' (Halkier, 2011). Following this, it is thus evident that in order to explore and assess particular aspects about sustainable energy consumption initiatives, it is necessary to establish research questions that *include* particular types of inquiries, which at the same time arguably *exclude* other types of inquiries. In order to undertake identification and assessment of the SECIs and their embedded *problem framings*, a database template was developed through which specific aspects of each SECI could be explored and described. In total 30 categories were established (a more detailed description of which can be found in Jensen et al. (2018, p. 301)). These categories enabled the researchers undertaking the review to explore the SECIs according to several themes. Central to the assessment was if and how the SECIs take practices or situations as targets for intervention for sustainability, rather than targeting individual behavior, 'choice', or technical innovation in isolation (Shove, 2010; Spurling et al., 2013; Shove and Walker, 2014). To conduct such an assessment, categories were established to make inquiries about scale, stated objectives, methods of evaluation, governance and types of outputs. Thus, the database enables a multifaceted exploration of the 'problem framings' within which actors (including initiators, partners, funders, etc.) in the SECIs might operate. It is important to note that while the framework enables an assessment of potential problem framings embedded in the SECI, and across actors involved, it is *not* designed to facilitate a comprehensive cross-evaluation of their successfulness. To this extent, quantifiable impacts, such as reductions in emissions, reductions in energy use, participant satisfaction rate, etc., may be of various types and scales, thus making comparative analysis difficult. Undertaking such an assessment requires more detailed studies of each SECI, which is outside the scope of the large-scale review.

Each of the SECIs included in the database was coded through a categorized assessment of the empirical material. Central, overarching categories, such as stated objectives, outputs, types of output, areas of consumption targeted, methods- and medium of intervention, and type of change were taken as point of departure. In coding the SECIs through this assessment, themes emerged for a typology of problem framings.

Although the database-template framework was inspired by the work of Spurling et al. (2013), the empirical data showed that SECIs were hard to explicitly define within each of the suggested six framings, as several of them overlap. It did however also become evident that

Table 4
Examples of themes coming out of empirical inquiry through a selection of assessment categories, resulting in typological categories.

Assessment category Typology category	Objectives	Methods of intervention	Consumption area targeted	Type of output	Type of change
Changes in technology	Focus is on providing householders with opportunities to make technological improvements on their homes.	Information, sometimes monetary incentives and legislation, some forms of experimentation	Often non-specific energy use, and if specific it has a technological focus (e.g. heating- or lighting systems)	Emissions and energy saved	Technological, mostly at appliance and building level.
Changes in individuals behavior	Focus is on raising awareness about climate change and energy use. Often focus on energy efficiency.	Information, campaigns, training and some forms of peer-to-peer learning	Often unspecific; general electricity use	Energy efficiency in use or appliances, sometimes raised awareness	Often non-specific; focus on behavior as a matter of energy awareness. Sometimes including specific measures of nudging.
Changes in everyday-life situations	Changing consumption patterns by targeting need/configuration for instance by substituting practices (for instance away from private driving towards public transportation)	Often a broad mix, usually an element of community and more experimental forms of deliberation, such as collaboration or 'living lab' approaches	Often specific in relation to particular domains in or related to the home (heating, use of water, cooking). Can be more general, but then often with a focus of using less (sufficiency)	Often expressed through changes in consumption patterns related to energy use, less explicitly about energy use. Sometimes expressed through energy demand reductions.	Often expressed as changes in practices related to household specific situations (cooking and in relation to heating). Often about changes in mobility patterns.
Changes in complex interactions	Often expressed as changes across 'supply and demand'; can be development of new relations between renewable energy systems providers and users; new ways of building; new ways of living, development of professional as well as everyday life practices. Often related to specific locations.	Often a broad mix, very often involving experimentation and community based action.	Often several areas targeted, and often across professional practices (eg building, banking, planning) and household related practices (with several forms of energy use)	Often a mix of better performance of buildings and changes in energy demand. Often resulting in new relationships across professional and everyday life domains. Often involving new ways of planning.	Often expressed as changes in several types of consumption patterns and as changes in how practices interlock.

many of the SECIs operating most closely within the two main types of problem framings as suggested by Southerton and Welch (2018) were not either behavioral or system-oriented. Hence, the need to develop an alternative problem framing typology became evident.

Based on the systematic assessment of the large database, four types of problem framings could be derived (Table 4). Two correspond to what Spurling et al. (2013) categorizes as common framings in policy interventions, and two correspond to what Spurling et al. (2013) and Southerton and Welch (2018) characterize as reconfiguring systems of practices across production and consumption.

After each SECI had been assessed and coded, each partner in ENERGISE reviewed the codes from initiatives based in their own countries. As each partner is a specialist within their own country, with knowledge about and experience with national SECIs, national policy and national socio-material configurations of energy consumption levels, this peer-review provided a quality check of the coding of the database of 1067 SECIs.

In the following section, the Problem Framing Typology, comprised of the four categories briefly introduced above, is presented in more detail. This is done to explicitly describe each of the four problem framings identified in terms of embedded assumptions related to 1) potential for change, 2) various actors and their role in change processes, and 3) the responsibility for making change happen.

4. Types and prevalence of problem framings in SECIs across Europe

The Problem Framing Typology (PFT) presented in this section consists of four different categories under which a SECI can be classified, depending on the predominant problem framing approach that the SECI (re)produces. In the following, each category of the PFT is described in more detail. The establishment of each category is based on empirical, analytical assessment (as exemplified in Table 4), as well as assessments of findings and recommendations from similar research-based efforts, such as those carried out by Southerton et al. (2011), Spurling et al. (2013), Foulds et al. (2017), Labanca and Bertoldi (2018) and Southerton and Welch (2018) (as exemplified in Table 1). For each category, a *generalized example* is provided for illustration (also see Tables 5–9 for a summary with examples of SECIs from the database). Finally, the distribution of SECIs on the PFT is provided in Table 10.

4.1. Changes in technology

This problem framing assumes that changing levels in energy use is a matter of technological change, upon which consumers may have to react. Within this problem framing, it is often assumed that technological change will happen in the context of social stasis, and therefore people or practices are rarely included as active agents for – or objects of - change. The main goal is to reduce energy consumption levels through technological innovation, be it innovation in buildings and household appliances, or larger scale transformations of the energy system, such as going from fossil fuel to renewable energy sources.

SECIs that are classified under this category often entail the following characteristics:

- Sustainable energy consumption is seen as a matter of technological change through optimization and efficiency.
- The social organization of everyday life is never or rarely included in the objectives or targets of intervention. Social changes may happen due to technological changes, but will most likely be regarded as 'unintended consequences'. Technology is the main 'change-agent'.
- Methods of interventions are often information, feedback, monetary incentives, energy inspections, (technological) experimentation and legal requirements.
- Responsibility for change lies within technological optimization and

Table 5
Specific database examples of SECIs included in Problem Framing category Changes in Technology. For more information on the examples, please consult http://energise-project.eu/projects.

SECIs	Objectives	Methods of Intervention	Type of (envisaged) Output	Actors involved	Change-agent
HSY:n (FI)	Reducing use of fossil energy in heating and electricity	Information	More energy efficient buildings, diffusion of solar PV	Map of heat and solar potentials, technical experts (?), residents (as recipients)	Technology
Renewable Energy Dublin (IE)	Upgrading the building fabric, installing heating control, and a thermostat fitted in each apartment.	Monetary incentives	Electricity and heat consumption reduced, money saved	New technologies and insulation companies. Tenants.	Technology through retrofitting

adoption of these technologies.

- Often comparable to conceptualizations such as 'innovating technology' in Spurling et al. (2013) and draws on mechanism that resembles the mechanisms put forward in the 'material context' as defined by Southerton et al. (2011).

The category, and the SECIs that are incorporated within this category, range from optimization of household products to developing new and energy efficient buildings. In all instances, technological or product optimization is seen as the main driver for change towards sustainable energy consumption. The bases and organizations of (social) life, which generates certain levels of energy consumption, are not challenged. If people are included as an active agent in change process, this problem framing will often see change as a matter of changes in individual behavior, which is closely related to the next category, described below.

A general illustration of a SECI underpinned by this problem framing would be if energy consumption related to laundry is solely (or at least primarily) understood to be a matter of optimizing laundry machines. This could also include a focus on providing technical labeling for laundry-related appliances so that the 'consumer' can easily navigate between them in terms of energy efficiency. SECIs like these would however neither explicitly challenge the number of laundry cycles that people carry out, nor would they challenge any notions related to keeping clean. Neither would SECIs within this category explicitly challenge what is understood to be 'clean clothes' in different contexts and situations.

4.2. Changes in individuals behavior

This problem framing assumes that changing levels of energy use is a matter of changing individuals' behavior in terms their (personal) energy use. Within this type of problem framing it is often assumed that change will come about through mechanisms such as social marketing or nudging, encouraging individuals to adopt more sustainable behavior. Behaviors are in this problem framing often understood as comprised of attitudes, choices and motivation and will change when under pressure from external factors. Essential to this problem framing is that it (often) assumes autonomy of individual choice. The problem framing thus targets individuals, often as 'consumers'.

SECIs that are classified under this category often entail the following characteristics:

- Sustainable energy consumption is seen as a matter of adopting sustainable behavior. The SECIs in this category often assume that change towards sustainability is a matter of individuals changing behavior by changing attitudes and choosing sustainable products.
- Social norms might be considered as *contexts* of behavior change, but social norms in themselves are rarely challenged and experimented with.
- Adoption of the same rationales within the category *changes in technology*. However, instead of relying on technological changes alone, SECIs in this category add other measures such as campaigning for more energy efficient versions of certain behaviors. Some SECIs may use education as a means for change, but often treats education as knowledge that is acquired/transferred 'as is', more than something that needs to be learned and performed.
- SECIs within this category often carry with them the assumption that the knowledge and policies that the SECI draws on for its problem framing are not normatively loaded or guided themselves, and that sustainable behavior initiatives are 'external' to what is being changed and can thus be 'implemented'. Individuals are the main 'change-agents'.
- Methods of interventions are often (tailored) information, campaigns, training, education, some forms of peer-to-peer learning and monetary incentives.

Table 6
Specific database examples of SECIs included in Problem Framing category Changes in Indivduals behavior. For more information on the examples, please consult http://energise-project.eu/projects.

SECIs	Objectives	Methods of Intervention	Type of (envisaged) Output	Actors involved	Change-agent
clever heizen! (DE)	Promoting energy savings within households through a combination of technical efficiency and behavioral change.	Consultation and information	Residential heating systems optimized for efficiency, and behaviors optimized for efficient heating.	Optimized heating systems, people adapting behaviors an expert consultancy on technological efficient and efficient use.	Technology and behavior related to the use of the technology
TRIBE (e.g. SE)	Contribute to a citizen's behavior change towards energy efficiency in public buildings, through their engagement in social games	Games	Accelerating deployment of innovative ICT solutions for energy efficiency; greater consumer understanding and engagement in energy efficiency; Relative reductions in energy use.	Researchers, ICT, users of public buildings	ICT that nudges change in behaviors

- Responsibility for change lies with the individual, assuming the individual will change with access to the 'right' information.
- Often comparable to conceptualizations such as 'shifting consumer choices' and 'changing behavior' in Spurling et al. (2013), and draws on mechanisms that resembles the mechanisms put forward in the 'individual context' and the 'social context' as defined by Southerton et al. (2011).

The category, and the SECIs that are incorporated within this category, range from providing information about opportunities for selecting energy efficient products to adopting more energy efficient lifestyles.

To continue the illustration given above, SECIs targeting laundry related energy consumption, underpinned by this problem framing, might go a bit further than relying on energy efficiency labeling of products, by providing more information about why it is good for the consumer to choose an efficient laundry machine, or why the consumer should wash colder or use particular types of detergents. Information provided may focus on monetary incentives or it may address ecological consequences of not choosing the most energy efficient or ecological option. It does not challenge social conventions such as the number of laundry cycles, why clothes are washed in the first place, or what it means to feel clean.

Common to both approaches is that the *individual* is put forward as the target for change, and that the 'responsibility' for change lies with the individual. Shove (2010) classifies this approach as the ABC model, and argues that this way of allocating responsibility with the individual (consumer) is exactly why it has gained much popularity in policy-related reports and models for (sustainability) change. Further, the spaces for change produced by these problem framings are relatively narrow, as they include only individual people or individual products to change within a black-boxed social context.

Importantly, the two problem framings presented above can produce changes in practices as a result of their efforts, but these changes are often unintended, and may often result in direct rebound effects or other indirect shifts in consumption patterns (see Cool Bizz example in Shove, 2014). As the SECIs included for assessment are all located in relatively well-off European contexts, direct rebound effects or indirect, resource intensive shifts in consumption patterns that may result in stagnating or even increasing energy consumption are generally undesirable (with the exception of those experiencing energy poverty, for example). Purposefully avoiding (negative) unintended consequences requires that problem framing and related representations of change to a larger extent recognizes the social embeddedness of practices across systems and domains (Sahakian and Dobigny, 2017). It also requires opening up the 'space' for intervention and allowing for strategies to be reflexive enough to welcome changes in the strategy itself as the intervention processes unfold (Voß and Kemp, 2006). The following two categories represent aspects of how such a process can take place.

4.3. Changes in everyday life situations

This problem framing assumes that changing levels of energy use is a matter of changing material components, images, norms and competences related to specific areas of daily life. Within this type of problem framing, it is often assumed that an understanding of these aspects can be obtained by exploring and understanding what people use energy for (Shove and Walker, 2014), and targeting what energy is used for rather than targeting energy consumption as a value in itself. The use of water, heating and energy is seen and understood as a result of 'everyday life situations'. Although people are seen as active agents in change processes, it is the everyday life situations that are targeted and sometimes challenged, and peoples behaviors are regarded (collectively) as a result of – and dependent on - situated everyday life dynamics.

Table 7
Specific database examples of SECIs included in Problem Framing category Changes in Everyday Life Situations. For more information on the examples, please consult http://energise-project.eu/projects.

SECIs	Objectives	Methods of Intervention	Type of (envisaged) Output	Actors involved	Change-agent
Responsi-ble Cooling (AT)	To find ways to cool down/cool the body that does not require electricity and air-conditioning	Situations targeted, officials using paper fans to cool off at events, children's events with fresh fruit, structural changes in buildings and alternative heating and cooling technologies	CO2 emissions reduced, situations where cooling is needed to be changed.	Children, adults, officials, experts	Practices of keeping cool without electricity
Grøn Forskel (DK)	Showcasing how everyday life situations, such as cooking or shopping for clothes can be more sustainable (vegetarian alternatives, shopping second-hand); beyond that of energy use itself.	Social Media	Substituting practices; e.g. moving away from buying new clothes of virgin materials towards buying second-hand); circular economic thinking	Bloggers, media, people, energy supplier	Everyday life situations, people, ideas, norms as well as structural changes.

SECIs that are classified under this category often entail the following characteristics:

- Targeting what energy and heating is used for, and not energy and heating in itself. This is however often done without explicitly considering connections between activities and situations that are not directly observed as co-dependent. Therefore if cooking or dining situations are targeted, they might be targeted as singular instances that are not deeply dependent on the synchronization and timing of several aspects of the everyday life and society in general.
- Social, material and habitual aspects of everyday life situations appear to be targeted and experimented with. People interacting in particular situations are 'change-agents', and it is often acknowledged that situations have been shaped over time and space, wherefore historical deliberation may be included in the experimental assessment.
- Often emphasizes social or collective aspects of methods of intervention, and could include participatory methods, such as some forms of peer-to-peer learning, collaboration, living labs, training, experiments and a community focus. When information campaigns are a method of intervention, they are often (if not always) combined with other forms of intervention.
- Responsibility for change is shared amongst groups of people and technology.
- Often comparable to conceptualizations such as 'substituting practices' or 'recrafting practices' in Spurling et al. (2013), and draws on several of the mechanisms put forward within and across 'contexts' as defined by Southerton et al. (2011). *However, and importantly, SECIs that are classified under this category would not treat individual, social and material aspects of change as 'contexts' for behavior, but rather as (important) 'constituents' of behaviors.*

The category, and the SECIs that are included within this category, range from acknowledging everyday life and its organization as a constituent for energy use (and consumption) in the design of the intervention, to experimenting with and challenging various kinds of everyday situations, such as cooking and driving (mobility). Common for all parts of the scale within this category is that it appears that everyday life situations, and not only behaviors, are the target of intervention, and it seems that it is acknowledged that everyday life is tied up in different kinds of configurations of materials, skills and meanings related to everyday practices (cooking, showering, shopping, driving, etc.).

Continuing along the lines of the illustrations given above, SECIs that seek to address laundry related energy consumption, and which are underpinned by *this problem framing, would approach the challenge of energy consumption all together differently than the two previously described problem framings*. Here, the situations of everyday life that have an implication for the way, and the frequency, with which people launder, as well as these situations themselves, would be the 'unit' of intervention. SECIs would address the situations that generate laundry, and would thus target routines and ideas related to how, why and when different types of garments are deemed 'launder-able'. This could for instance be in terms of challenging the frequency with which people wash their clothes, which is often connected to different ideas about cleanliness and comfort (that can vary across the situations that generates laundry; e.g. work, social events and sport). Solution spaces could include developing opportunities for shared spaces to do laundry (sharing of machines), providing space for air-drying instead of tumble-drying or making available other ways of keeping clothes presentable (spot-cleaning, ironing, etc). In that way, SECIs underpinned by this problem framing may address understandings of cleanliness and material aspects of doing laundry, and it may employ a notion of sufficiency rather than efficiency (see Sahakian et al. (2019) for details on sufficiency based SECIs).

4.4. Changes in complex interactions

This problem framing assumes that changing levels of energy use is a matter of changing complex interactions between several areas of household related activities, professions and sectors. Within this type of problem framing a broader assumption is included, that 'social organization' is the key target for change, and that water, heat and energy consumption happens because of certain ways of organizing daily life across domains, sectors and practices. This category is broader than the previous category 'changes in everyday life' as it goes beyond exploring and targeting what happens within a home, to include targeting relations to particular systems of provision, be it product-service systems, utilities, construction sites, banks and work places.

SECIs that are classified under this category often entail the following characteristics;

- The space for intervention opportunities and change is 'bigger', more complex and involves several measures taken.
- Multiple actors in and across several sectors as well as practices are involved.
- Unlike the problem framing '*changes in individuals behaviors*', the 'responsibility' for change is shared between multiple actors from different 'domains' of society (businesses, utilities, residents, and policymakers to some extent).
- Often includes (several) methods of interventions such as training, education, new business models, experimentation, and community building. SECIs in this category often consist of several initiatives, or are part of an umbrella of other initiatives.
- SECIs within this category ideally have a more 'reflexive' (see Voß and Kemp, 2006) understanding of the knowledge and policies that it draws on, and change is seen as a process of emergence and knowledge production that happens between all actors involved in the initiative or change process. In other words, change agents or actors are not perceived to be 'outside' of what is being changed, but rather a (dynamic) part of it.
- Often comparable with conceptualizations such as 'changing the way practices interlock' in Spurling et al. (2013) and draws on several of the mechanisms put forward within and across 'contexts' as defined by Southerton et al. (2011). *However, as with the previous category, SECIs that are classified under this category would not treat individual, social and material aspects of change as 'contexts' for behavior, but rather as (important) 'constituents' of behaviors.*

The category, and the SECIs that are classified within this category, range from those that focus on changing configurations of existing energy demands to enabling new forms of engagements with renewable energy and visions of sufficiency. Common for them all is that multiple actors are involved and various ways of organizing society in terms of energy provision and consumption are challenged.

In line with illustrative examples given above, SECIs that target energy consumption related to laundry, and which are underpinned by this problem framing, would focus on challenging current ideas about cleanliness and routines related to the frequency with which people launder. It would as well argue for (or ideally even enable) political and legislative changes in terms of how clothes and laundry machines are produced, so that they last longer and are easier to repair. SECIs would target a wider range of actors, challenge existing ways of organizing everyday life around buying, wearing and washing clothes. Initiatives such as repair cafés as well as networks for sharing, swapping or reusing clothes and laundry machines might be supported. Eco-communities often resemble such attempts, by socially and materially organizing different ways for keeping clothes clean without washing frequently as well as providing spaces for sharing, which enable people to engage in alternative clothing- and laundry related practices.

Table 8
Examples of SECIs included in Problem Framing category Changes in Complex Interactions. For more information on the examples, please consult http://energise-project.eu/projects.

SECIs	Objectives	Methods of Intervention	Type of (envisaged) Output	Actors involved	Change-agent
Wir Leben 2000 Watts (AT)	Aiming for a 2000 W society by 2050 by addressing changes in multiple aspects of everyday life	Research, campaigns, commitment-strategies; sufficiency rather than efficiency	Structural changes; changes in ideas about what a good life is; an absolute reduction in energy use	Broad range of actors needed in process	Systemic change; new ideas about 'a good life'
Eco Gozo (MT)	Making an island sustainable	Community engagement; local sustainable development strategy	Promoting and enabling sustainable lifestyles with low environmental impacts	Broad range of actors involved, cross-sectoral; planners, residents,	Island life

Table 9
Summary of Problem Framing Typology with examples.

Category	Description	Example
Changes in technology	This problem framing assumes that changing levels in energy use is a matter of technological change	HSY:n project in Helsinki, focused on optimizing existing products so they become more energy efficient; technical innovation; focusing on large-scale technical changes from fossil fuel to renewable energy
Changes in individual's behavior	This problem framing assumes that changing levels of energy use is a matter of changing individuals' behavior in terms their (personal) energy use, and their attitudes and choices related to energy efficiency	Clever Heizen! in Germany runs an information campaign that seeks to convince the individual about rational use of energy in relation to heating, and to maintain their heating systems accordingly.
Changes in everyday life situations	This problem framing assumes that changing levels of energy use is a matter of changing material components, images/norms and competences related to specific areas of daily life.	Responsible Cooling aims at understanding, challenging, engaging with and enabling (new) meanings, skills and material arrangements related to keeping cool on hot summer days. The project targets various situations and offer up alternative ways of keeping cool (paper fans and cold, fresh fruit).
Changes in complex interactions	This problem framing assumes that changing levels of energy use is a matter of changing complex interactions between several areas of household related activities, professions and sectors. This includes assuming that 'social organization' is the key target for change, and that water, heat and energy consumption happens because of certain ways of organizing daily life across domains, sectors and practices.	Wir Leben 2000 W in Austria targets a change in systems of energy provision, configurations of energy demand, including various actors involved in (re) procuring certain dynamics of existing or new systems of production and consumption, in order to obtain good lives below 2000 W.

4.5. Quantification of the prevalence of problem framings in recent sustainable energy consumption initiatives

Strikingly, but maybe not surprisingly, the number of SECIs categorized as 'changes in everyday life situations' and 'changes in complex interactions' are few, where as the majority of SECIs can be categorized under 'changes in technology' as well as 'changes in individuals behavior'. This result aligns with current critiques, indicating the dominant focus on individual behavior change programs (e.g. Shove, 2010) and energy efficiency schemes (e.g. Shove, 2017). Interestingly, a large share of the SECIs were classified under the category 'changes in technology' in spite of the critical case sample that the identified SECIs comprised. The overall share of technologically focused energy related change initiatives across Europe is therefore presumably much higher than the share identified here. Further, it is interesting to note that SECIs that are categorized under 'changes in technology' and 'changes in individuals behavior' are 'bigger' in terms of scales, as these SECIs tend to be unspecific in targets and seek to reach a high number of households at the expense of any type of situatedness. So the share of behaviorally oriented or technocratic problem framings are much higher, in terms of scale and exposure, than the share coming out of the categorized assessment alone. SECIs categorized under 'changes in everyday life situations' and 'changes in complex systems' tend to generally be more situated and local.

5. Discussion: resulting implications for energy policy

Prevailing sustainable energy consumption initiatives (SECIs) tend to rely mostly on changes in technology or changes in individual behaviors. However, given the long lead times necessary for large-scale changes toward both low-carbon energy-supply technologies and wider technological changes, supply-side changes alone cannot deliver the near-term, deep cuts in emissions necessary for even a low probability of meeting the ambitions of the Paris Agreement (Southerton and Welch, 2018). Further, relying on behavior change programs that to a large extent expect the individual to make the necessary changes is equally not likely to be enough to meet the requirements, and actions that go beyond 'business as usual' are needed (Bjørn et al., 2018). The relatively small share of SECIs that challenge the status quo by questioning everyday life dynamics and promoting larger systemic changes are a welcome contribution to the sustainable transformation of societies, but change is not happening at the speed and scale required in spite of the existing initiatives that do try to push more radical forms of change. Although this study's findings provide an interesting case of the prevailing need for challenging predominant types of problem framings within (local) energy policy and approaches, the review does not provide much information about a number of related issues that warrant further research and assessment, *such as how initiatives are evaluated as well as what kind of outputs are brought about and in what way*. A few

Table 10
Overview of resulting share of problem framings and geographical scale of administration[a].

	No. Initiatives	% of total initiatives	Local/Regional	National/Cross-national
Sustainable energy consumption initiatives (SECIs) - total	***1067***	***100***	***398***	***669***
Change as changes in technology	284	26.6	101	183
Change as changes in individual behavior	513	48	153	360
Change as changes in everyday life situations	123	11.5	56	67
Change as changes in complex interactions	147	13.8	88	59

[a] It is important to note that the typologized SECIs have been categorized as a result of a collaborative approach within the ENERGISE consortium, as mentioned in section 3. However, the ENERGISE consortium recognizes that the typologization of the SECI can be subject to change, if actors from identified SECIs objects to the category within which they have been placed Our Open Access Database (http://energise-project.eu/projects) currently contains 1067 SECIs that have been reviewed and classified by the summer of 2017. The results presented here are a snapshot of the data analysis conducted until Summer 2018 however the study is an ongoing iterative process (?) and actors from all identified SECIs are encouraged to review, revise and engage with the team in debate about problem framings of the sustainability challenge.

reflections on some of these shortcomings are described below, as they provide relevant and critical implications for energy policy.

First of all, the review provides little information about the extent that reductions in energy use and/or CO_2 emissions have been obtained, across all types of SECIs. This is for several reasons. Some SECIs provided no information on outputs, and the ones that did were often not explicit about the units within which the outputs were measured. Evaluation schemes are closely connected to the problem framings within which the initiative has been carried out, and thus outputs are reported on in various ways (if at all), such as in monetary terms, or in relative efficiency terms (a 10% reduction, but with no reference to what it is a 10% reduction of). Only very few initiatives set out to reach absolute reductions, for example 'Wir leben 2000 W' (Table 8), and thus reports on outputs in absolute terms. Nonetheless, it may be beneficial to learn from these types of initiatives in relation to what mechanisms they employ and how they do it. In doing so, it is important to note that although some of these SECIs may draw on mechanisms that are also appearing in SECIs drawing on more conventional problem framings, such as information sharing and regulatory measures, they draw on these with *a different purpose*. For example, information sharing may be facilitated from within the changes that occur, for instance as it happens in Grøn Forskel as depicted in Table 7, where experiments and reflections are shared between several actors, instead of being regarded as a mechanism through which top-down advice can simply be transferred. Equally, in SECIs that are underpinned by problem framings that take point of departure in systemic changes, a broad variety of actors are included in the process, and ideas about a good and appropriate life may be deliberated and discussed (as happens in Wir Leben 2000 Watts, depicted in Table 8), rather than black-boxed.

Second, the results of the review may not only reflect 'intentional' and explicitly addressed ideas about change, but also a number of vested interests, such as sunk investments and obstinate infrastructural conditions established by others than SECI initiators and directly involved actors, which includes prevailing ideas about capitalism, green growth and so on, which the SECIs initiators (and other participating actors) cannot confront and change alone. Changing perspectives on how energy demand is a problem for society and the environment thus means challenging the way that nature and the environment is valuated in political and economic perspectives. For policy, this aspect makes up a crucial problem, as economic thinking plays a crucial role in what types of initiatives are deemed 'measurable', and therefore promoted and funded.

Finally, understanding changes in energy consumption as a matter of changes in everyday life situations and complex social and material interactions in society means taking seriously that policy neither can nor should aspire to 'silver bullet solutions'. Society and 'everyday life' is different across countries and even within countries. Therefore, policies need to consider socio-material constitutions of energy demand and energy systems, as well as cultural contexts (for example, see Naef et al., 2019). One way of addressing this issue is to embed systemic approaches within the conceptualization of spaces for intervention and change. As they become wider and broader, responsibility for change is shared amongst a larger set of actors, and the notion of 'normality' can discussed and challenged across a larger set of actors and stakeholders. In doing so, attention may also be drawn to whether energy reduction is seen as a matter of efficiency (making existing patterns efficient) or as a matter of reconfiguration (questioning whether existing patterns are meaningful and necessary and for whom).

6. Concluding remarks and perspectives for future research

This paper has reported on a problem framing typology emerging from a large-scale review of existing sustainable energy consumption initiatives (SECIs) carried out across 30 European countries. The review has focused on exploring the content, scope and scale of the SECIs to interrogate the way in which reducing energy demand is considered a challenge in the SECIs, which is closely related to the underpinning problem framing.

The findings from the review show that at least 75% of existing SECIs understand energy use and demand as a matter primarily of changes in technology or as changes in individual behaviors. The responsibility for change is therefore primarily allocated to that of technological performance or on the individual as the 'consumer'. This is concerning for several reasons. First, these assumptions disregard any potential negative changes happening due to technological changes, which often include a shift in resource intensive activities rather than an actual reduction, since time or money saved may simply be used to do other (resource intensive) things. Further limitations of energy efficient improvement strategies are due to the fact that the ways of thinking about energy efficiency are themselves 'performative' and that they end up perpetuating meanings and levels of services related to existing (unsustainable) types and patterns of consumption, rather than effectively challenging them.

Second, it thus seems worthwhile to pay attention to how the remaining 25% of the SECIs take on an alternative approach to energy consumption, by treating it as a matter of everyday life situations and changes in complex material and social interactions of society. Notably, several of these SECIs regard changes in energy consumption levels as a matter of understanding what is 'sufficient' rather than 'efficient', and as something for which several societal actors are responsible for changing. These aspects are under-researched and require more attention.

Researching SECIs that resonate with alternative problem framings may provide useful insights into how energy consumption levels can be challenged practically for particular places at particular points in time. Many of these SECIs challenge existing regulations (that are underpinned by prevailing technological or behaviorally oriented problem framings), which may be counter-productive or even obstructive for SECIs that seek to build on alternative problem framings (i.e. practice-based and systemic perspectives). Exploring these tensions in greater detail could provide valuable insights for sustainable transformation in residential energy use.

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